



Ontology-Driven Information Integration

Models developed in different domains of expertise can be automatically integrated.

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Ontology-driven information integration (ODII) is a method of computerized, automated sharing of information among specialists who have expertise in different domains and who are members of subdivisions of a large, complex enterprise (e.g., an engineering project, a government agency, or a business). In ODII, one uses rigorous mathematical techniques to develop computational models of engineering and/or business information and processes. These models are then used to develop software tools that support the reliable processing and exchange of information among the subdivisions of this enterprise or between this enterprise and other enterprises.

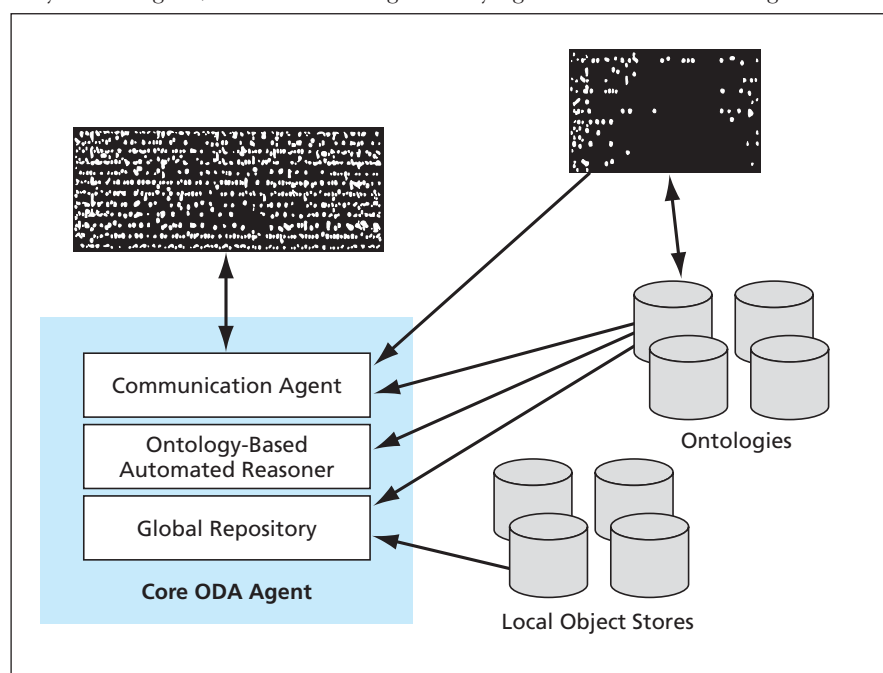
The need for ODII arises because in the absence of an automated means of integrating information, enterprises and subdivisions of enterprises tend to become somewhat isolated from each other, making the overall enterprises less efficient than they could otherwise be. The information generated in various domains of knowledge in organizational subdivisions is typically stored in the form of models. Consequently, to a large degree, the information-integration problem reduces to a problem of integration of models. The primary source of the model-integration problem is the fact that the experts in each different domain use a different modeling method with its own syntax for constructing models and its own semantics for interpreting the constructions. (This combination of syntax and semantics, together with any other explicit and/or implicit background information specific to the domain, is denoted loosely as the "ontology" of the domain for the purposes of ODII.) Hence, to move information from models in one domain to those in another domain, it is necessary to use a human or computer "translator." Of course, translation by humans would be too inefficient to enable integration of models in real time. ODII was conceived to provide real-time computer translation.

ODII is best summarized in terms of some of the concepts and constructs

that have been formalized at various stages of its development. The construct of one of the earlier stages is an ontology-driven information-integration architecture (ODA) based on the concept of an agent (the core ODA agent) that performs the information-integration functions. As depicted schematically in the figure, the core ODA agent

and it enables the core ODA agent to propagate those implications to the relevant experts in the various domains.

The ontology-based automated reasoner is responsible for detecting conflicts, propagating changes, and maintaining consistency in the global repository. It is also responsible for notifying the communication agent of new



The ODA is a conceptual architecture for implementation of ODII.

comprises a communication agent, an ontology-based automated reasoner, and a global repository.

The communication agent is responsible for enabling the integration of modeling software tools in the computational environment and transferring information from and to those tools that have been integrated. It receives information from integrated tools and communicates the information to the global repository for storage and to the automated reasoner for propagation of changes and maintenance of consistency. Thus, it keeps the core ODA apprised of the information generated within each domain and, hence, enables the core ODA agent to determine the implications of that information in all relevant contexts;

information that has been deduced so that this information can be propagated back to the various experts working on the given project. It uses the constraints defined in the ontology library to perform its function. It thus keeps the core ODA agent aware of all the constraints that connect the objects and activities in the various domains.

The global repository is responsible for storing, updating, and retrieving information available about a project. It receives updated information from the communication agent and from the automated reasoner. The information contained in the global repository can be browsed and edited through a graphical user interface. Even though the global repository is conceptually

considered one knowledge base, the information can be physically stored in networked databases (represented by the local object stores in the figure). The ontologies of the domains relevant to the enterprise at hand are considered part of the global repository. Hence, the global repository provides the necessary background knowledge for all relevant domains.

Other ODII developments to date include the following:

- The ODA has been implemented in a software system called the Integrated Design System Environment (IDSE).
- An ODA subarchitecture denoted the design rationale management (DRM)

framework has been devised as a means to capture information on the reasons for design choices. This information is needed in ODII because failure to understand design rationale severely limits reuse of design information and makes it difficult to determine whether proposed design modifications are acceptable.

- A prototype program called the Ontology Capture and Browsing Tool (OCBT) has been incorporated into IDSE. OCBT provides support for capturing and browsing ontologies through a user-friendly graphical interface. A commercial version of OCBT, called IDEF5, was under devel-

opment at the time of reporting the information for this article.

- Also under development at the time of reporting was the Generic Application Framework (GAPP) computer program, which is intended to provide integration among models developed in different domains and to display all models within a single computational environment.

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